



The Software Defined Radio

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Theme

In today's environment of constantly changing requirements and technological advancements, it is imperative to be flexible and adaptable. Software defined digital radios provide an affordable means to adapt to the ever changing requirements imposed by frequency congestion, technological advancements, and the ever increasing demand for more data.

Discussion Points

- **Fundamental problems with current systems**
- **Hardware implications 25kHz to 8.33kHz**
- **What are we trying to solve with SDRs**
- **Vision: Software Defined Radios**
 - **Concept**
 - **Advantages**
 - **Challenges**
 - **Software**
 - **Hardware**
 - **Current program status**
 - **US DoD vs. commercial implementation**
 - **Adapting passenger multimedia systems**
 - **Questions / Comments**

Fundamental problems with current systems

- Single use / function radios
- Fixed frequency band
- Fixed bandwidth
- Limited / no data or networking capability
- Technically difficult to upgrade
- Costly to upgrade
- Significant cost impact to upgrade aircraft
- Hardware changes drive software changes
- Software changes drive hardware changes
- Lack of ability to interoperate with dissimilar forces
- Unable to adapt to unique frequency allocations
- Complex network management
- Proprietary standards

Why JTRS or SDR?

- Joint and coalition military operations require interoperability and capability far beyond that of legacy systems

... Too many workarounds in the field today

- Current generation communications systems are hardware-oriented and are an expensive diversity of equipment to maintain

... JTRS offers significant cost savings over time

- No growth capability in legacy systems to meet rapidly expanding communications needs



Hardware implications - 25kHz to 8.33kHz

- Initial thought was that the change to 8.33 kHz was a straight forward change
 - Commercial limited frequency (VHF ATC only) radios had little impact
 - Multi-mode / multi-band radios had significant difficulties
 - Interference was prevalent in large metropolitan areas
 - Radio would not meet compliance without significant filtering
 - Each attempt to resolve issues drove both hardware and software changes with significant cost

What are we trying to solve with SDRs

- **Interoperability**

- Today's international cooperation require the ability to communicate with diverse forces and functions
- Communications with civil police / fire / rescue forces imperative
- Adapting to changing civil aviation requirements

- **Affordability**

- Shrinking budgets require making the most of your money
- Software changes shouldn't always drive hardware changes
- Reduction of overall platform systems
- Total ownership cost reductions by managing impact to platforms

- **Flexibility**

- Adapt to changing frequency allocations
- Move to ad-hoc networking capabilities
- React to dynamic mission changes

Vision: Software Defined Radios

Current Systems (25-30 Families) (750, 000 Radios)

- Navigation
- Positioning
- Location
- Identification
- Air to Ground
- Air to Air
- Ground to Ground
- SATCOM



AN/PSQ-6A EPLRS



AN/ARC-210



AN/WCS-3 UHF SATCOM/LOS



AN/ARC-201A SINCGARS



ANPRC-119 SINCGARS



AN/PSC-5

Common Open Standards Architecture & Technology Base



Legacy Waveforms Commercial Waveforms New Military Waveforms

Joint Solution (1 Family)

OPERATIONAL

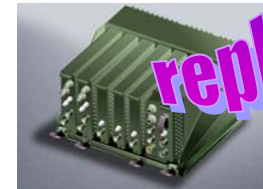
Space

Airborne

Maritime/
Fixed Station

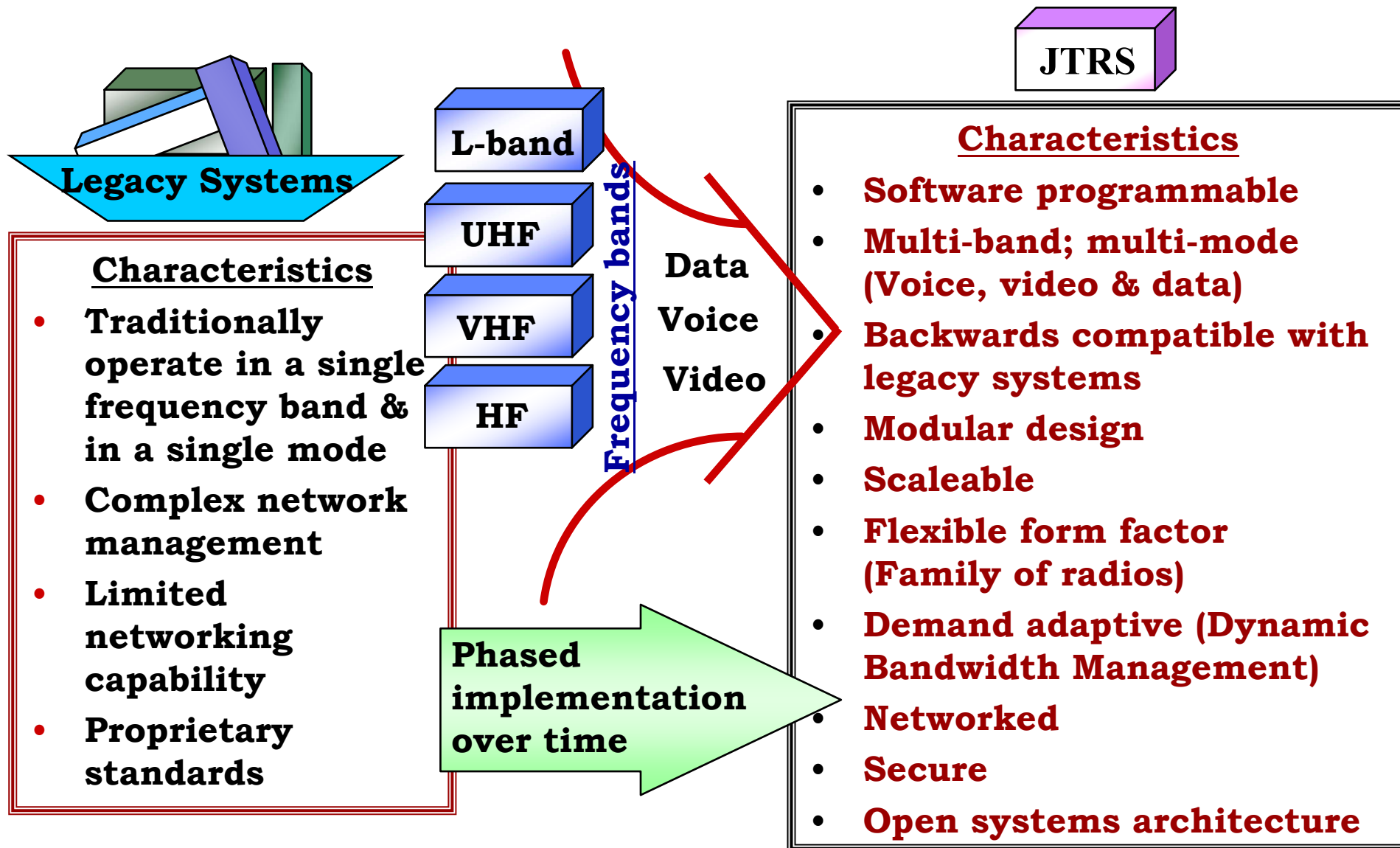
Ground Forces

- Hand held
- Dismounted
- Vehicular



A family of common Radios and Waveforms
built around a standard open architecture

JTRS / SDR Concept: Advantages



JTRS / SDR Concept: Challenges

- Replacement of the proliferation of existing systems
 - 3/4 million + in US DoD alone
- Managing impact to platform integration
 - Input / Output devices
 - Mission computers
 - Form / fit / function
- Overcoming export paradigms
 - SDR mirrors the Personal Computer model
 - Waveforms = software applications

- Software Communications Architecture (SCA)
 - Current version SCA V 2.2
 - Published and available on the JTRS Joint Program Office website
 - Submitted to OMG for international open systems standard approval
 - Architecture was developed / validated by an industry consortium
 - Rockwell Collins / Raytheon / ITT / BAE Systems
- Waveforms = applications
 - Minimum of 33 different waveforms for the US DoD
 - Covers applications from 2 MHz to 2 GHz
 - HF
 - VHF
 - UHF
 - L-band
 - Developing a new Wideband Networking Waveform
 - 5+ Mbps data capable per channel

Hardware



- Previous hardware functions are now accomplished in software
 - Modems
 - Encryption
- Programmable bandwidth (30+ MHz)
- Flexible I/O
 - Partitioned to allow for easy modification to support unique platform interfaces
- Size / Weight / Power
 - Flexible design allows for easy repackaging to support customer requirements



Current program status

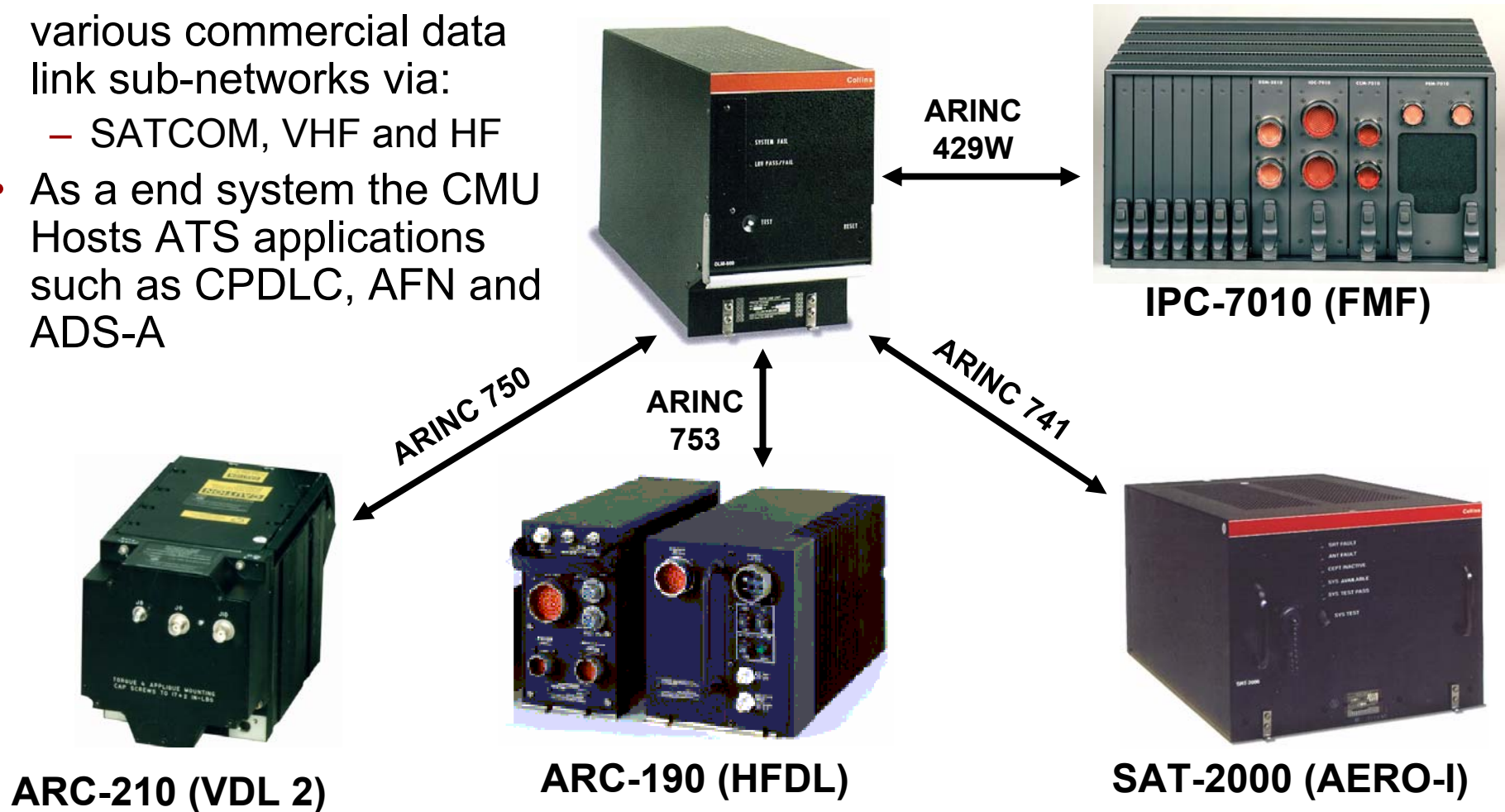
- US Army awarded JTRS Cluster 1 contract June 2002
 - Rockwell Collins / Boeing / TRW / BAE Systems
 - Addresses all US DoD ground vehicles
 - Addresses US Army rotary wing aircraft
 - Currently in design & development – production delivery 2006
- US Air Force preparing to issue Request for Proposal for the Airborne Cluster 4
 - Addresses all remaining US DoD aircraft

US DoD vs. commercial implementation

- US DoD systems are traditionally significantly more expensive than commercial systems
- Acquisition and development are slow compared to commercial practices
- Total ownership cost reductions could make system acquisition cost irrelevant
- Flexibility and maintainability of systems will be attractive to commercial applications
- Technology improvements will mirror PC market
- A move towards combined use of commercial and military products is underway in the military
 - Just a matter of time until commercial markets adapt military products that provide significant networking / bandwidth improvements

Combined Use of Commercial and Military Products

- CMU Provides access to various commercial data link sub-networks via:
 - SATCOM, VHF and HF
- As a end system the CMU Hosts ATS applications such as CPDLC, AFN and ADS-A



Adapting to passenger multimedia systems

- Networking is the future of all airborne communications
 - ATC
 - Military
 - Passenger multimedia / entertainment systems
- Bringing higher bandwidth to the platforms allows passengers the ability to have an office or an entertainment system in the sky
 - Executive office suites
 - Passenger entertainment
 - Military command and control
 - Military tactical situational awareness

Summary

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Questions / Comments